

J. Jpn. Bot. **85**: 370–373 (2010)

Okihito YANO^a, Kumiko ITO^b, Teruo KATSUYAMA^c, Hiroshi IKEDA^a and Takuji HOSHINO^{b,*}: **Cytological Study of *Carex omurae* and *C. phaeodon* (Cyperaceae)**

スルガスゲとハシナガカンスゲ（カヤツリグサ科）の細胞学的研究（矢野興一^a, 伊藤久美子^b, 勝山輝男^c, 池田 博^a, 星野卓二^{b,*}）

Summary: A cytological study of two narrow endemic *Carex* (Cyperaceae), *C. omurae* T. Koyama and *C. phaeodon* T. Koyama, was performed. Chromosome numbers of *C. omurae* (2n = 32) and *C. phaeodon* (2n = 30) were determined in this study for the first time. Phylogenetic relationships of *C. omurae* and *C. phaeodon*, with their allied species, are discussed.

The genus *Carex* (Cyperaceae) is one of the most species-rich genera of flowering plants in Japan, with over 200 species reported (Akiyama 1955, Katsuyama 2005). Koyama (1955) described two new species, *C. omurae* and *C. phaeodon*, from the Chubu District, central Japan: *C. omurae* from Shizuoka and Aichi Prefectures, and *C. phaeodon* from Yamanashi and Shizuoka Prefectures. These two species are designated as endangered species in Japan on account of their narrow range of distribution (Environmental Agency of Japan 2000).

Koyama (1955) considered *C. omurae* to be closely related to *C. conica* Boott (sect. *Mitratae*), and he assigned *C. phaeodon* to sect. *Frigidae*. Katsuyama (2005) checked the type specimens of *C. omurae*, and he determined that the paratype collected from Aichi Prefecture was

not *C. omurae*, but *C. conica* itself. Moreover, Katsuyama (2005) moved *C. phaeodon* from sect. *Frigidae* to sect. *Mitratae*, due the similarity between *C. phaeodon* and *C. foliosissima* F. Schmidt.

Cytological studies have proven useful for understanding the close relationships between the narrow endemic Japanese *Carex* species and their allied widely distributed species (Yano et al. 2006, 2007a, 2007b).

Chromosome numbers of *C. omurae* and *C. phaeodon* have not been reported, and there is no discussion on the phylogeny of the two species from their cytological features. This paper reports the chromosome numbers of *C. omurae* and *C. phaeodon*, and discusses their relationships with their allied species.

Karyomorphological observations were undertaken on the somatic chromosomes of *C. omurae* and *C. phaeodon* using the meristematic cells of root tips. The methods used for chromosome observation followed Yano et al. (2006). Details for the voucher specimens, deposited in the Herbarium of Okayama University of Science (OKAY), and localities of

Table 1. Species, localities, voucher specimens, and chromosome numbers of two Japanese *Carex*

| Species, locality, and voucher specimen | Chromosome number (2n) |
|---|------------------------|
| <i>C. omurae</i> T. Koyama | |
| Shizuoka Pref., Shizuoka-shi, Aoi-ku; T. Hoshino & al. 17871 (OKAY), O. Yano & al. 21476-4 (OKAY) | 32 |
| <i>C. phaeodon</i> T. Koyama | |
| Yamanashi Pref., Minami-Koma-gun, Nanbu-cho; T. Hoshino & al. 17890 (OKAY) | 30 |
| Shizuoka Pref., Numazu-shi, Takazawa; T. Hoshino & al. 17907 (OKAY) | 30 |

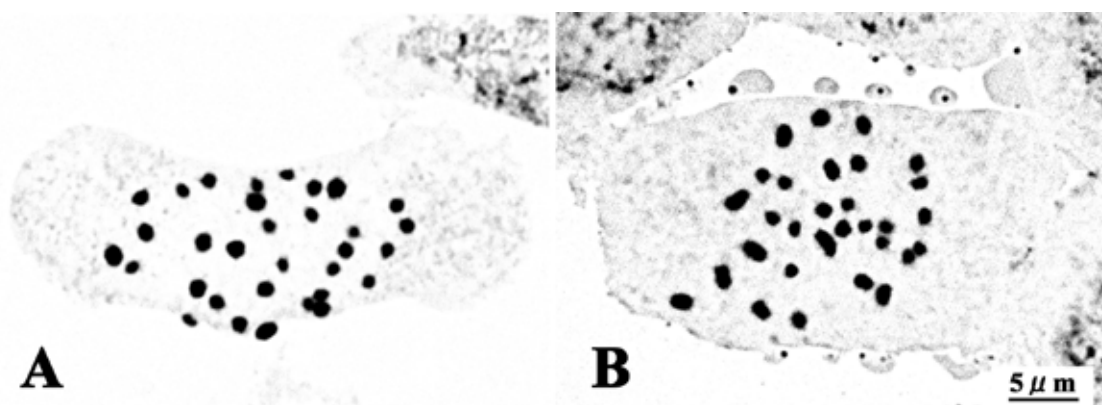


Fig. 1. Photomicrographs of somatic metaphase chromosomes of two Japanese *Carex*. A. *Carex omurae* ($2n = 32$). B. *C. phaeodon* ($2n = 30$).

the materials are listed in Table 1.

The chromosome numbers determined in this study are shown in Table 1. *Carex omurae* had the chromosome number of $2n = 32$, the first report for this species. Somatic metaphase chromosomes ranged from 1.0 to 1.6 μm in length (Fig. 1A). Koyama (1955) considered that *C. omurae* was closely related to *C. conica*, widely distributed from Hokkaido to Kyushu in Japan, and also in southern Korea (Katsuyama 2005). The chromosome number of *C. conica* was reported as $2n = 32\text{--}38$ by Tanaka (1948), Hoshino (1981), and Hoshino and Waterway (1994). Hoshino and Waterway (1994) reported the apparent correlation between geography and infraspecific aneuploidy in *C. conica*: among the aneuploids, the $2n = 32$ cytotype was found on the Seto Inland Sea region and nearby coastal areas of the Chugoku and the Shikoku Districts, western Japan. *Carex omurae* is distributed at Abe-toge Pass, Shizuoka Prefecture, central Japan (Katsuyama 2005), and *C. conica* in this area showed the $2n = 34$ chromosome number (Hoshino and Waterway 1994). Chromosome number of *C. omurae* differs from that of *C. conica* in this area.

Morphologically, *C. omurae* is similar not only to *C. conica*, but also to *C. morrowii* Boott, *C. temnolepis* Franch., or *C. foliosissima*,

sharing cylindrical pistillate spikes with densely aggregated perigynia (Katsuyama 2005). *Carex conica* differs from the allied species by having hairy perigynia while others have glabrous ones. Cytologically, chromosome number of *C. morrowii*, *C. temnolepis*, and *C. foliosissima* are different from that of *C. omurae*: *C. morrowii* has $2n = 38$ (Tanaka 1948, Hoshino 1981, Yano et al. 2007a, Oda 2008), *C. temnolepis* has $2n = 36, 38$ (Hoshino 1981, Oda 2008, Yano et al. 2008), and *C. foliosissima* has $2n = 30$ (Tanaka 1948, Hoshino 1981, Yano et al. 2008). In conclusion our result cannot determine the accurate relationship of *C. omurae*, from combined morphological and cytological features.

Carex phaeodon had the chromosome number of $2n = 30$, the first record for this species. Somatic metaphase chromosomes ranged from 1.0 to 2.0 μm in length (Fig. 1B). Koyama (1955) assigned *C. phaeodon* to the section *Frigidae*, although at the same time he noted that *C. phaeodon* resembled *C. oshimensis* Nakai (sect. *Mitratae*). Katsuyama (2005) treated *C. phaeodon* as a member of sect. *Mitratae*, by its resemblance to *C. foliosissima* (sect. *Mitratae*). The chromosome number of *C. oshimensis* has been reported as $2n = 38$ (Okuno 1940), and that of *C. foliosissima* as $2n = 30$ (Tanaka 1948, Hoshino 1981, Yano et al. 2008).

Our cytological result supports that *C. phaeodon* is closely related to *C. foliosissima*, rather than *C. oshimensis*, judged from the chromosome numbers.

Carex omurae and *C. phaeodon* are distributed in narrow areas in Shizuoka and Yamanashi Prefectures, and they are thought to be one of the members of the "Fossa Magna region" defined by Maekawa (1949, 1974). They might be derived from ancestral taxa in this region. Future studies, including a phylogenetic study based on DNA sequences, will reveal the phylogeny and speciation of *C. omurae* and *C. phaeodon*.

The authors thank Dr. Mark F. Watson, Royal Botanic Garden Edinburgh, for his critical reading and correcting the English manuscript. We also thank Ms. Tomomi Masaki, Okayama University of Science, and Mr. Wataru Ohnishi, Kanagawa Prefectural Museum of Natural History, for their help on collecting materials. This study was partly supported by the Sasakawa Scientific Research Grant from The Japan Science Society, No. 19-503 (to O. Y.).

References

- Akiyama S. 1955. Carices of the Far Eastern Region of Asia. 257 pp. Hokkaido University, Sapporo (in Japanese).
- Environmental Agency of Japan (ed.) 2000. Threatened Wildlife of Japan -Red Data Book 2nd ed.- vol. 8, Vascular Plants. 660 pp. Japan Wildlife Research Center, Tokyo (in Japanese).
- Hoshino T. 1981. Karyomorphological and cytogenetical studies on aneuploidy in *Carex*. J. Sci. Hiroshima Univ., Ser. B., Div. 2, Bot. **17**: 155-238.
- Hoshino T. and Waterway M. J. 1994. Cytogeography and meiotic chromosome configurations of six intraspecific aneuploids of *Carex conica* Boott (*Cyperaceae*) in Japan. J. Plant Res. **107**: 131-138.
- Katsuyama T. 2005. *Carex* of Japan. 376 pp. Bun-ichi Co., Ltd., Tokyo (in Japanese).
- Koyama T. 1955. Taxonomic study of *Carex* in eastern Asia 2. J. Jpn. Bot. **30**: 309-318.
- Maekawa F. 1949. Makinoesia and its bearing to Oriental Asiatic flora. J. Jpn. Bot. **24**: 91-96 (in Japanese with English abstract).
- Maekawa F. 1974. The present flora: its general features and regional divisions. In: Numata M. (ed.), the Flora and Vegetation of Japan. pp. 58-86. Kodansha Ltd., Tokyo.
- Oda J. 2008. Taxonomic status and geographical variation of aneuploids of *Carex temnolepis* Franch. (*Cyperaceae*). J. Jpn. Cyperology (13): 23-28 (in Japanese with English abstract).
- Okuno S. 1940. On the chromosome numbers in the genus *Carex*. Jpn. J. Genet. **16**: 164-170 (in Japanese with English abstract).
- Tanaka N. 1948. The Problem of Aneuploidy. Biological Contribution in Japan, 4. Hokuryukan, Tokyo (in Japanese).
- Yano O., Katsuyama T. and Hoshino T. 2006. Cytological studies of seven taxa of *Cyperaceae* collected from the Bonin (Ogasawara) Islands. J. Jpn. Bot. **81**: 98-102.
- Yano O., Katsuyama T. and Hoshino T. 2008. Cytological studies of Japanese *Carex* (*Cyperaceae*) I. J. Jpn. Cyperology (13): 9-21 (in Japanese with English abstract).
- Yano O., Ito K. and Hoshino T. 2007a. Cytological studies of the genus *Carex* (*Cyperaceae*) in the Osumi Islands (Kagoshima Prefecture) II. Chromosome counts of four species collected from the Kuroshima Island. J. Jpn. Bot. **82**: 106-111.
- Yano O., Nanami T., Ito K., Ikeda H. and Hoshino T. 2007b. Cytological studies of the genus *Carex* (*Cyperaceae*) in the Osumi Islands (Kagoshima Prefecture) I. Chromosome counts of five species collected from the Yakushima Island. J. Jpn. Bot. **82**: 29-33.
- 狭域分布種で絶滅危惧種であるスルガスゲ *Carex omurae* T. Koyama とハシナガカンスゲ *C. phaeodon* T. Koyama (カヤツリグサ科) について細胞学的研究をおこなった。スルガスゲは静岡県安倍峠にのみ知られる種であり、染色体数は $2n = 32$ であった。また、ハシナガカンスゲは山梨県から静岡県にかけて分布する種であり、染色体数は $2n = 30$ であった。この2種の染色体数については今回が初めての報告である。スルガスゲはこれまで言われてきたヒメカンスゲ *C. conica* Boott に加え、カンスゲ *C. morrowii* Boott、ホソバカンスゲ *C. temnolepis* Franch.,あるいはオクノカンスゲ *C. foliosissima* F. Schmidt とも近縁であると考えられた。ハシナガカンスゲはオオシマカンスゲ *C. oshimensis* Nakai やオクノカンスゲとの類縁が考えられているが、染色体数はオクノカンスゲと同じであった。スルガスゲとハシナガカンスゲは、その分布からフォッサマグナ要素の植物であると考えられる。

^(a)Department of Botany, the University Museum, the University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-0033 JAPAN;

^a 東京大学総合研究博物館植物部門,

^bDepartment of Biosphere–Geosphere System Science,
Graduate School of Informatics,
Okayama University of Science,
1–1, Ridai-cho, Okayama-shi,
Okayama, 700–0005 JAPAN;

*Corresponding author: hoshino@big.ous.ac.jp

^b岡山理科大学大学院総合情報研究科
生物地球システム専攻、

^cKanagawa Prefectural Museum of Natural History,
499, Iriuda, Odawara-shi,
Kanagawa, 250–0031 JAPAN

^c神奈川県立生命の星・地球博物館)

植物研究雑誌 85: 373–376 (2010)

ミチノクホタルイの分布南限と生育立地 (大森威宏)

Takehiro OHMORI: Southernmost Localities of *Schoenoplectus orthorhizomatus* (Kats. Arai & Miyam.) Hayas. & H. Ohashi (*Cyperaceae*) and Its Habitats

Summary: *Schoenoplectus orthorhizomatus* (Kats. Arai & Miyam.) Hayas. & H. Ohashi (*Cyperaceae*), which has been known in northern Japan, is newly recorded from Oze, Mt. Hotaka and the Madarao Highland, in central Honshu, Japan. The species is distributed in areas covered with heavy-snowfall in winter from Hokkaido to central Japan. The species mainly grew in disturbed stands of fen, such as streamside of peatland, foot of peat plateau and trampled ground, while *S. hondoensis* (Ohwi) Soják, a close relative of *S. orthorhizomatus*, mainly grew in pools (undisturbed stands) of bog.

ミチノクホタルイの新産地

ミチノクホタルイ *Schoenoplectus orthorhizomatus* (Kats. Arai & Miyam.) Hayas. & H. Ohashi は、1997年に記載されたカヤツリグサ科の植物で、これまでに北海道と東北地方から記録がある (Arai and Miyamoto 1997, 早坂ほか 2008)。筆者は2008年8月10日に行われた群馬県の尾瀬保護専門委員調査の際に、利根郡片品村尾瀬ヶ原の背中アブリ田代で本種を採集した。また、2009年8月22日には尾瀬ヶ原の上田代、2009年8月26日には群馬県北部に位置する武尊山、2009年10月11日には長野・新潟県境に位置する斑尾高原からもミチノクホタルイを確認した (Fig. 1)。従来ミチノクホタルイの南限産地として福島県裏磐梯地域が知られていたが (早坂ほか 2008)、今回記録さ

れた地点は裏磐梯から南西ないし西南西方向に、直線距離で110～180 km離れた位置にあり、分布の南限である (Fig. 1)。

今回の調査でミチノクホタルイの分布は北海道から東北地方を経て本州中部の多雪地域である尾瀬・武尊山周辺、さらに長野・新潟県境域に分布が及んでいることが明らかになった。本種の

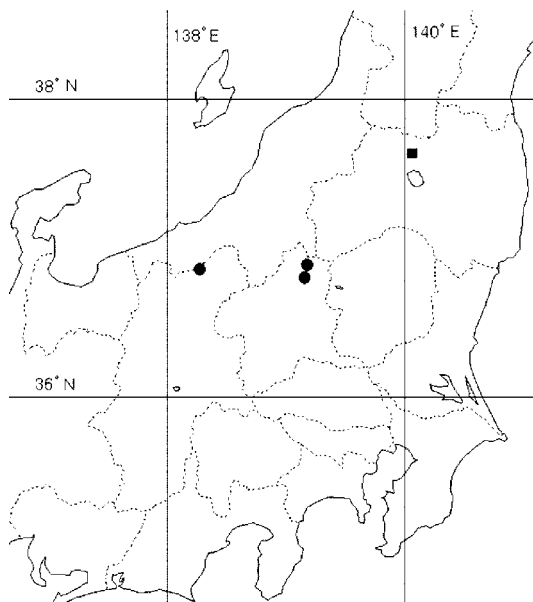


Fig. 1. Distribution of *Schoenoplectus orthorhizomatus* in central Japan (●) and southern Tohoku District (■: after Hayasaka et al. 2008).